

Family Planning and Contraception

Introduction and a History of Hormones

Two hormones need to be considered when selecting a form of contraception. Not surprisingly, they are **progesterone** and **estrogen**. More specifically, they are synthetic progestins and estradiols (estradiol is a natural hormone, one of the several estrogens produced in the human body, but as synthetic estradiols are used in contraceptives, we chose to use “estradiol” here to distinguish between exogenous synthetic estradiol and endogenous estrogens).

Synthetic estradiols are used to suppress the production of FSH—the effect of estrogen on the gonadotropes—thereby limiting follicular growth. **Progestins** are used to suppress the LH surge by doing what progesterone does—alter gene transcription in the hypothalamus to limit pulsatility, alter gene transcription in gonadotropes to limit LH and GnRH receptor production, and limit uterine proliferation and terminal differentiation. Systemic progestins silence the axis and cause the endometrium to atrophy. Estradiols are always used with progestins, called **combined contraception** (initially referred to as combined oral contraception, but there are now numerous methods of delivery, so “oral” is no longer necessary). The goal of combined hormone therapy is **anovulation**, achieved by keeping LH and FSH levels very low while the contraception is used. **Estradiols also induce the endometrium** to grow, necessitating a **hormone-free interval** (HFI) and subsequent **withdrawal bleed**. Continuous estradiol-containing contraception (i.e., administration without an HFI) results in sporadic intermenstrual bleeding as the endometrium proliferates beyond its blood supply. Therefore, estradiol-containing contraceptives require a number of withdrawal days to enable menses. Typical formulations include 21/7 (21 days of hormone, 7 days of sugar or iron pills) and 24/4 pill-withdrawal split packaging. The strategy was to mimic a “normal cycle” and permit “menses” every 28 days, or rather endure withdrawal bleeding every 28 days. There is no benefit to a withdrawal bleed except to clear out the endometrium (i.e., to control when the bleed happens). Over time, synthetic hormones were improved, and doses were lowered. Because **estradiol doses were lower**, the endometrium proliferated less, and thus there was less need for a withdrawal bleed—more time was spent on the active hormones, allowing regimens like 84/7. Because the **progestins got cleaner** and the doses were lower, there were fewer androgenic side effects.

When pills were the only hormonal contraception option, there were many brands, but every option came down to either combined oral contraception (COC) or the progestin-only pill (POP). Because the dose of progestin in POPs was much lower than that in COC, it was given the nickname “the mini-pill.” Despite it being taken orally, the effects of POPs were those of local progestins on the uterus—an endometrium inhospitable to implantation. It does **not stop ovulation**. Because its effect wears off after 22 hours, **rigid dose timing** had to be maintained. Because ovulation still occurred, and the effect of the pill wore off within a day, a spermatozoa could find an oocyte, fertilize it, a zygote could be formed (all in the uterine tube), and a blastocyst could implant every day (the 2 hours where the pill’s effect wears off). Therefore, POPs had a very **high failure rate**. The main reasons to be on a POP and not COC were **breastfeeding** and previous **deep vein thrombosis** or risk thereof. This risk was highest in women who were **on combined oral contraceptives**, were **over age 35**, and/or **smoked cigarettes**.

Failure rates on COC were high due to **user error**. The necessity of taking the dose every day made compliance challenging. Because the mechanism of action of COC is ovulation suppression, missing a dose or two could mean ovulation happened. So, as the problem was with compliance, pharma responded by changing the mechanism of delivery—**transvaginal rings** (dual hormone), transdermal **patches** (dual hormone), and **depot** (progestin only) formulations were created. Most of these were dual-hormone contraceptives for the prevention of ovulation. The rings (3 weeks) and patches (1 week) could be changed by the woman using them—instantly reversible. Still, the woman had to remember to change them. Their efficacy was better, but even their failure rate was high.

There is a **progestin-only injectable** formulation of **medroxyprogesterone**. This injection is administered in the office every 3 months. It isn't easily reversible, but 3 months is a relatively short duration. This was prescribed to the population most likely to have regular clinic visits—adolescents. Despite the need to see a healthcare provider every 3 months, it had a lower failure rate because the girls receiving it “got the shot and forgot” about it. There were no long-term risks to injections, and there were no concerns about the infection and infertility associated with intrauterine devices (IUDs). Those concerns turned out to be false, but when they were a concern, it made sense not to implant devices into a developing girl's uterus.

Due to the success of injectable contraception (because the person receiving it didn't have to remember to take a pill every day), contraception formulations that lasted for years, including **intrauterine devices** and the **etonogestrel implant**, were developed. The original IUDs were **copper** and not hormonal at all (discussed in detail below). Now, there are several options—copper IUDs, **levonorgestrel-releasing IUDs** (LNG-IUDs), and **the etonogestrel implant**. These devices have lower failure rates than surgical sterilization. They work—really well.

Initially, implants and IUDs were only placed in women who already had children. The concerns were that IUDs would cause uterine scarring, infection, or rupture and that hormones given to adolescents could affect puberty, increase risky sexual activity, or any other imagined consequence. They were reasonable concerns at first. IUDs have been shown to be removable, they do not impact fertility, and not only do they not increase infection rates, they actually **decrease pelvic inflammatory disease rates** (LNG-IUDs, specifically). Therefore, IUD placement is now recommended immediately **after every delivery** (and definitely before discharge), to **any adolescent** looking for contraception, and to **any woman not actively trying to conceive**. That is not just our personal opinion; it is guideline recommendation level 1A (with the best information and most certain benefit). This is why, in our challenge MCQs throughout the Organ Systems in the Basic Sciences, when the vignette includes a woman of reproductive age, she always has an LNG-IUD. Of course, if the vignette is about fertility, vaginal bleeding, or pregnancy, she does not have one.

Furthermore, these devices are not only prescribed for their contraceptive benefit. **Systemic progestin contraception is protective against cancer**—endometrial carcinoma (Müllerian epithelial cancers), epithelial ovarian carcinoma (also Müllerian epithelial cancers), and breast cancer (at least it should be, not yet proven). **Local progestin contraception** (e.g., LNG-IUD) is protective against endometrial carcinoma and epithelial ovarian carcinoma (i.e., ovarian tube cancer on the ovary).

A decision that used to involve choosing between pills based on need and risk, how much of this hormone and how much of that hormone, and endless formulations and combinations is now as simple as asking the patient which of the three forms of LARC (pronounced “lark”) she wants. Of course, all the prior options are still available, and the right kind is chosen based on the patient's preferences. This is what the rest of this lesson is about, starting with LARC (the best) and working through the other options, in order of descending efficacy, ending with methods for **increasing** the chance of conception.

This is truly a family planning lesson with a great deal of emphasis on contraception.

Long-Acting Reversible Contraception

LARC is recommended for all women of reproductive age who are not actively trying to conceive. **Menses stop** after 1 year with a progestin-releasing device. Systemic progesterone silences the axis and the endometrium. It takes a while for the progestin in the device to achieve control, so symptoms gradually improve over the first year of their use. Some women continue to ovulate, especially with locally acting LNG-IUDs; however, with dual-hormone contraception—systemic progestin—most cycles stop. There is still some follicular activity as these women do not go through menopause while on contraception (even on forms of contraception that do not contain estradiol).

There are essentially three types of LARC: implantable devices that silence the axis via systemic progestin, progestin-releasing IUDs that do not silence the axis but rather silence the endometrium locally, and nonhormonal IUDs. These are the recommended first-line contraceptives due to their low side-effect profiles, low failure rate, and ease of use. They can be removed at any time (even prior to the “expiration date” of the device). The **only differences** between LARC and **any other method** are that **continuation rates are higher**, and **contraception is more effective** on LARC. Because they are placed and need no consideration again for years, they are, in all situations, absolutely indicated. The method chosen depends on the woman’s preference. Only the progestin-releasing implant carries a theoretical risk for breastfeeding mothers, but progestins tend to have no ill effect on baby (estradiols do, as excess estrogen can end up in breast milk).

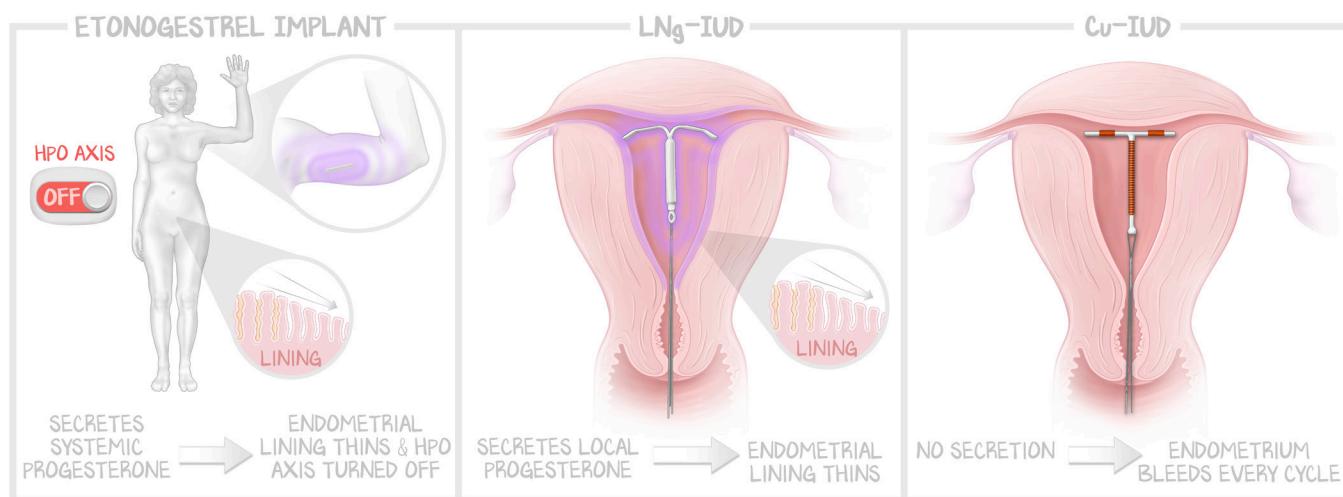


Figure 2.1: Long-acting Removable Contraception

The etonogestrel implant provides systemic progestin, turning off the HPO axis and preventing ovarian cycles, thereby preventing both endometrial proliferation and ovarian ovulation. The levonorgestrel intrauterine device both creates a physical barrier to implantation and releases progestin locally. This leaves the HPO axis active while atrophying the endometrium, preventing menses as long as the device remains in place. Copper intrauterine devices act as a physical barrier alone. These induce heavy menstrual bleeding but come without hormones.

Implants. The only implantable contraceptive currently used in the United States is Nexplanon (formerly Implanon). The implant is a single, 4-cm plastic rod that provides a slow, continuous release of **etonogestrel** (a progestin) to silence the axis and **suppress ovulation**. It is implanted under the skin in the upper arm and remains effective for 4–5 years. In fact, it is the most effective form of contraception available, with a pregnancy rate of 0.1%. Because it releases progestin systemically, there is **no ovulation**, and because systemic progestin affects the endometrium, there are **no menses**. There is a risk of the implant becoming lodged in deeper tissues, after which it is no longer palpable. Nexplanon is **radiopaque**, whereas the older Implanon was not; therefore, if Nexplanon becomes embedded and is no longer palpable, it can be located through routine imaging (e.g., x-ray, ultrasound). This avoids the need for (elective) exploratory surgery to find and remove it. The inability to easily locate and retrieve the older devices (which we assume was unintentional) effectively caused women without the means to afford elective surgery to remove their devices (historically, black and indigenous people of color) to endure prolonged sterilization.

LNG-IUDs are inserted into the uterus through the cervix and can remain in place for up to 5 years. The majority of their effect is **local to the endometrium**, where the progestin acts to inhibit proliferation and terminally differentiate the endometrium. Even if an oocyte is fertilized, the **physical device prevents implantation**, and there is **no endometrium in which to implant**. The systemic effects on

the HPO axis vary. Some women become anovulatory, an effect of systemic progestin. However, the majority of women remain ovulatory and without alteration to their ovarian cycles, and they may still experience the effects of cycling estrogen (e.g., breast swelling, mood changes), so LNG-IUDs are not as good at preventing breast cancer as the implant. The fact that LNG-IUDs decrease the risk of epithelial ovarian cancers, but do not fully inhibit ovulation or the HPO axis, further strengthens the idea that epithelial ovarian cancers are not truly of the ovary. Because endometrial proliferation is continuously inhibited, LNG-IUDs are ideal for the **prevention of endometrial carcinoma** and for women with **heavy menstrual bleeding**.

The **copper IUD** is the longest-lasting LARC on the market. It is highly effective, with pregnancy rates of less than 1%, and can be used for up to 12 years. It is also highly effective as emergency contraception when inserted within 5 days of unprotected intercourse. **Copper IUDs interfere with implantation** but do **not offer the benefits of progesterone**, and because the ovarian cycle regulates the uterine cycle, women will **still have regular menses**. Because copper IUDs do not prohibit endometrial proliferation and are merely physical devices, they are actually likely to **worsen bleeding**. Therefore, they may not be a good choice for women with heavy menstrual bleeding. Women may choose the copper IUD to avoid the theoretical side effects of progesterone on breastfeeding or because they prefer its duration of action (10 years before they need to replace it). We go into more practical detail in the section on emergency contraception.

Serious complications, such as IUD expulsion, contraceptive failure, and uterine perforation, are incredibly rare. Historically, IUDs were thought to increase the risk of serious pelvic infections. Newer evidence from studies on current devices does not support this. However, pelvic infections should be treated prior to the insertion of a device to prevent spreading the infection to the upper reproductive tract. Patients may also worry that an IUD will increase the risk of ectopic pregnancy. In fact, IUDs are highly effective at preventing all types of pregnancy, including ectopic pregnancy. However, in the rare cases of contraceptive failure with IUDs, ectopic pregnancy occurs at a slightly higher rate than in those without IUDs—the device interferes with implantation, so if implantation does occur, it will be in a bad spot not protected by the IUD. The same is true of ectopic pregnancy after a tubal sterilization procedure—surgical sterilization has a higher rate of ectopic pregnancy than IUDs do.

CONTRACEPTIVE	FAILURE RATE	DURATION	MECHANISM OF ACTION	SIDE EFFECTS AND CHALLENGES
Contraceptive implant (Nexplanon)	0.1%	3 years	Ovulation suppression	Irregular bleeding/spotting that eventually resolves
Intrauterine device (levonorgestrel)	0.1%	3-5 years	Prevent implantation Prevent endometrial proliferation	Ovarian cycles continue, breast and mood changes not affected Intended amenorrhea
Intrauterine device (copper)	0.8%	12 years	Prevent implantation Sperm inactivation	Heavier menses as ovarian and uterine cycles continue

Table 2.1: Comparison of LARC Types

Green, progestin-only methods; blue, nonhormonal method.

Permanent Sterilization

Prior to the advent of highly effective LARC, permanent sterilization was considered the gold standard of contraception, and it is still the most common form of contraception for women who no longer desire fertility. Surgical sterilization is effective at preventing pregnancy, does not require continuous care, and provides an alternative for patients with contraindications to or reservations about other contraception methods. In addition to counseling on the surgical risks, patients must be counseled on the permanent nature of sterilization and the risk of later regret. For this reason, permanent surgical sterilization may not be offered to young women (under age 30) without extenuating circumstances. Sterilization procedures are available for men (vasectomy) and women (tubal ligation, salpingectomy, or hysterectomy).

Tubal sterilization methods include ligation and occlusion methods, as well as partial or complete salpingectomy. Pregnancy rates are less than 1% but vary slightly by procedure. Pregnancy rates are **higher with surgical sterilization than with LARC**. The success rate can be improved by removing more organs—a ligation is less effective than a salpingectomy (removal of the uterine tubes), and a salpingectomy is less effective than a total hysterectomy with bilateral oophorectomy. The method used depends on the reason for sterilization and risk of disease—patients with *BRCA1/2* mutations should undergo prophylactic removal of the ovaries, uterus, and mammary glands (breasts). Bilateral tubal ligation is a quick procedure that can be performed at the time of cesarean delivery. A salpingectomy is easier to perform and more likely to prevent an ectopic pregnancy. You won't have to choose which method to use at this point in your training; we just want you to be informed about the methods available.

Generally, the standard surgical technique for female surgical sterilization is bilateral laparoscopic tubal ligation (LTL). Which technique is used is dependent on the operator's training and preference. Although each method has been shown to be as effective as all the others, salpingectomy theoretically has the greatest chance for success **and eliminates the risk of epithelial ovarian cancer** (uterine tube cancer on the ovary).

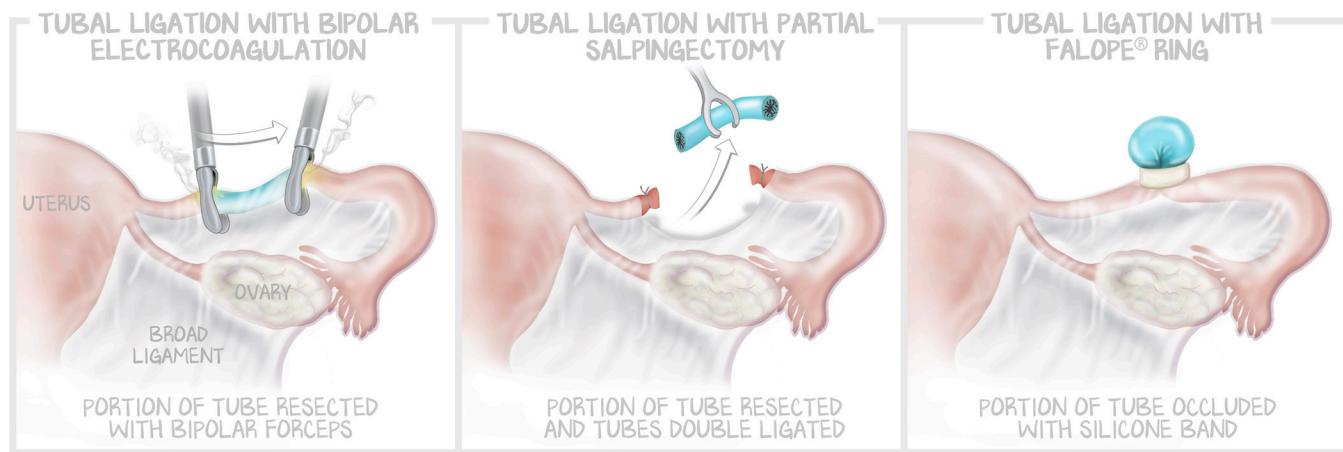


Figure 2.2: Intra-abdominal Tubal Ligation

These surgical sterilization methods can be performed at the time of cesarean delivery or as an elective laparoscopic procedure. In each method, the ampulla is targeted for ligation or removal.

Vasectomy is an unfortunately named procedure. The vas deferens are NOT removed during a vas-ectomy ("vas" meaning vas deferens [a term that we do not use], "ectomy" meaning the removal of). Instead, akin to tubal ligation in women, this procedure involves **ligation of the ductus deferens**. An incision is made in the scrotal sac, and the ductus deferens is cut and ligated on either side of the incision. This enables elective reanastomosis should fertility be desired in the future. Vasectomy is an outpatient procedure (performed

in the clinic) for male sterilization, and it is more effective, safer, and less procedurally morbid than tubal sterilization. Although tubal ligation and vasectomy are technically similar procedures, vasectomy is not performed by an OB/Gyn (the patient is of the wrong sex) but by a urologist. It is important to counsel patients that the procedure is **not immediately effective**. Until a semen analysis **confirms azoospermia**, alternative methods of contraception should be used. Azoospermia is usually achieved by 8 weeks post procedure, and the semen analysis is performed at week 12.

Bilateral hysteroscopic tubal ligation was a really good idea. It is akin to a “female vasectomy” in the sense that it can be performed quickly and with local anesthesia in the clinic, avoids entering the abdomen, and is theoretically reversible (at least, the devices could be removed). The only device that exists is the Essure device, owned by Bayer AG of Germany. The device has been removed from the market, is under investigation by the FDA, and is the subject of Netflix’s “The Bleeding Edge.” We are not endorsing Bayer AG or the Essure device, but we definitely support the idea of nonsurgical, permanent sterilization for women who want it. Other manufacturers could create a safer device that does the same thing.

Hysterectomy and **endometrial ablation** are not considered surgical sterilization techniques, though they would confer sterilization. They are performed for women who have conditions that indicate hysterectomy, and are not usually provided for surgical sterilization alone.

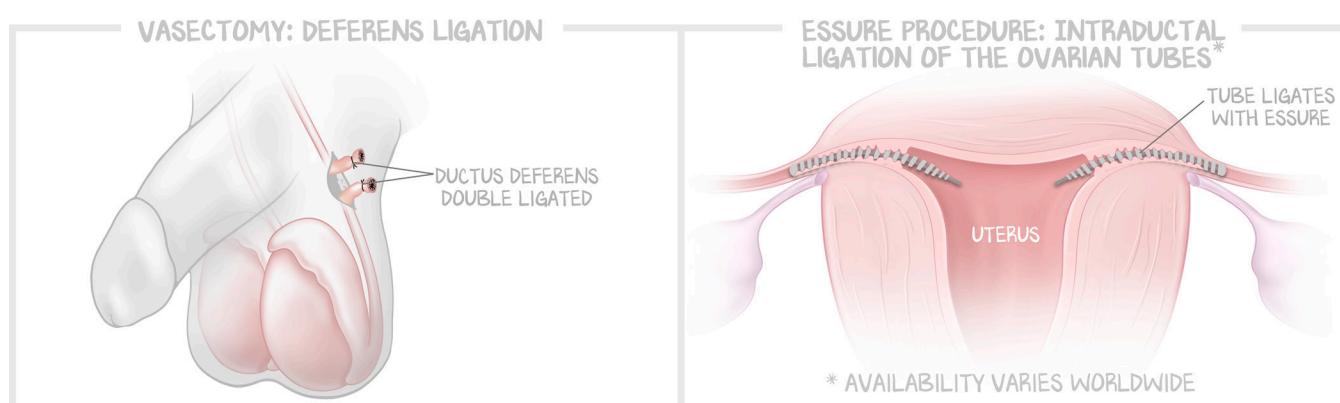


Figure 2.3: Extra-abdominal Surgical Sterilization

Vasectomy is a simple procedure performed in the office. It is fast, safe, and effective. The female version of a simple office procedure was the Essure procedure (trade name), the intraductal ligation of the uterine tubes. It was found to be unsafe and has been withdrawn from the U.S. market by the FDA.

CONTRACEPTIVE	FAILURE RATE	DURATION	MECHANISM OF ACTION	SIDE EFFECTS AND CHALLENGES
Tubal Sterilization	< 1%	Permanent	Prevention of oocyte and sperm migration	Surgical risks, Ectopic/tubal pregnancy
Vasectomy	0.15%	Permanent	Prevention of sperm migration	Minimal procedural risks Autoimmune orchitis Reversible in most cases

Table 2.2: Comparison of Surgical Sterilization Methods

Key: blue, nonhormonal methods.

Short-Acting Contraception: Progestin-Only Methods

Multiple temporary progestin-only contraceptives are available for women who desire them. They are associated with higher failure rates compared to those with permanent sterilization or LARC because they require continued effort on the part of the patient. POPs have the highest failure rate due to their short duration of action, and injectable medroxyprogesterone has the worst side effects of systemic progesterone. Both of these options are now considered worse than COC and LARC (Nexplanon [etonogestrel] or LNG-IUDs). But they are easier to administer (injection, no device) or can be reversed in a day (POPs).

Depo Provera is the brand name for **medroxyprogesterone acetate** injection, which provides contraception of intermediate duration—around 3 months. There is a little wiggle room, a 2-week grace period between when the medication wears off (12 weeks) and ovulation (2 weeks later), but compliance with clinic visits is essential for this method to be effective. Medroxyprogesterone injections are convenient and provide the benefits of **systemic progesterone** (both endometrial changes and anovulation) but require a visit to the clinic every 3 months for subsequent doses. With perfect use, pregnancy rates in the first year are estimated at 0.2%. However, coming into the office on a quarterly basis is a barrier to many patients. Thus, typical use results in a pregnancy rate of approximately 4% in the first year. Irregular bleeding and spotting are common side effects that decrease with continued use, and amenorrhea occurs in approximately 50% of patients after one year of use. **Weight gain** is a common concern with long-term medroxyprogesterone use, and systemic progesterone causes **decreased bone mineral density**, a product of decreased estrogen levels. This decrease is thought to be reversible after the treatment is discontinued and seems to be unique to medroxyprogesterone and not systemic progestins in general (i.e., not seen with etonogestrel implants). The effects of weight gain, low estrogen, and decreased bone mineral density are not seen with implantable preparations and seem to be unique to medroxyprogesterone. The return to fertility may be delayed after the last injection of medroxyprogesterone, particularly in women with high BMIs. Thus, it may not be a good option for women planning a pregnancy in the near future.

Progestin-only pills include drospirenone- and norethindrone- containing pills. The typical-use failure rate is likely higher than that of combined estradiol-progestin pills, but POPs present a reasonable alternative for patients with contraindications to estradiol-containing formulations. They do not reliably suppress ovulation but are still effective due to the thickening of the cervical mucus and thinning of the endometrial lining. As discussed above, strict timing is necessary for these to work. Even a single hour of delay can compromise their contraceptive efficacy. POPs are now rarely used because of the ease of IUDs, which are also safe for women with risk factors for deep-vein thrombosis.

CONTRACEPTIVE	FAILURE RATE	DURATION	MECHANISM	SIDE EFFECTS AND CHALLENGES
Intramuscular Injection (IM medroxy-progesterone)	4%	3 months	Ovulation suppression	Irregular bleeding/spotting, Reversible loss of bone mineral density Obesity, weight gain
Progestin-only Pill	7%	1 day	Progestin effects on the cervical mucus and endometrium	Irregular bleeding/spotting.

Table 2.3: Comparison of Short-acting Contraceptive Methods

Key: green, progestin-only methods.

Combined Estradiol and Progestin Methods

Combined estradiol- and progestin-containing contraceptive methods include transdermal patches, vaginal rings, and oral pills. They all work primarily through ovulation suppression. Their efficacy is dependent on adherence to the scheduled administration/application. Typical use results in a pregnancy rate of approximately 7%, whereas perfect use results in a pregnancy rate of 0.3%. The goal is **anovulation**. Because of the estradiol, there will be endometrial hyperplasia, and a **withdrawal bleed** due to a **hormone-free interval** is necessary. How often withdrawal bleeding occurs is now essentially up to the woman taking the medication. All forms of this contraception are reversible immediately—cessation of the medication will result in a withdrawal bleed and initiation of the follicular phase.

All estradiol-containing contraception increases the risk of thromboembolism, so it is unsuitable for patients who are already at high risk of developing thromboembolic disease. This includes postpartum patients and smokers age 35 and older. The most common side effects of estradiol-containing contraception are irregular bleeding and spotting. Some patients also report other hormone-related side effects, such as mood changes, breast tenderness, and headaches.

Transdermal patch. Transdermal contraceptive patches containing ethynodiol diacetate and norethindrone provide contraception for 1 week. A new patch is applied to the skin of the buttocks, back, or abdomen each week for the duration of the hormone period. For the HFI, no patch is applied.

Vaginal ring. Contraceptive rings are flexible plastic vaginal inserts containing ethynodiol diacetate and etonogestrel. They can remain in place for 3 weeks at a time and are removed during the fourth week. Like the patch, the HFI is simply the absence of a ring.

Combined oral contraceptives. COC is available in various formulations and doses. All must be taken daily. Most come with 3 weeks' worth of active pills and 1 week of inactive/placebo pills (some formulations provide iron pills instead of sugar pills during the HFI) to reinforce daily adherence. The HFI for older formulations is required more frequently (stronger estrogen effects on the endometrium) and for longer (21/7 being the most common). Now that the preparations have improved, as discussed in the introduction and history, 84/7 and 24/4 regimens are now available. We will explore this concept further in the challenge questions.

CONTRACEPTIVE	FAILURE RATE	DURATION	MECHANISM	SIDE EFFECTS AND CHALLENGES
Transdermal patch	7%	1 week	Suppression of ovulation	Breakthrough bleeding if used too long (hormone-free interval required)
Vaginal ring	7%	3 weeks		DVTs, especially in age \geq 35 tobacco smokers, and hypercoagulable state
Combined oral contraceptives	7%	1 day		Must be avoided in breast cancer, migraines, hypertension, liver disease, coronary artery disease, or any diabetic vasculopathy

Table 2.4: Comparison of Estradiol and Progestin Contraceptive Methods

Key: yellow, estradiol- and progestin-containing methods.

Pericoital Contraception

Pericoital contraception methods are used at the time of intercourse to prevent sperm from ascending into the female upper reproductive tract. These methods include spermicide, sponges, cervical caps, diaphragms, **male condoms**, and female condoms. Many patients enjoy the sense of control that these contraception methods provide in terms of when and with whom to use them. The lack of hormones in these methods may also be considered a benefit. The downside of these methods is that they are less discreet than other contraception methods, and they must be used correctly and consistently every time to be effective.

The **male condom** is a method of contraception that is the least under the woman's control, but it is the **most effective method of preventing the transmission of sexually transmitted infections** and **the only method** that prevents the **spread of HIV**. Proper use is paramount to that success. The condom must be placed while the penis is erect, with a reservoir left at the tip. The male condom functions by preventing the discharge of semen into the female reproductive tract. Therefore, space to collect the semen is required. The male condom also serves to separate the skin of the penis from the mucosa of the vagina, preventing contact contamination.

Spermicides are preparations of nonoxynol-9, which inactivates sperm. Spermicides come in cream, foam, or gel applications. Spermicides can be used alone or in combination with cervical caps, diaphragms, or sponges. Some patients and/or their partners experience vaginal or penile irritation with spermicides. Frequent spermicide use may increase HIV transmission rates. Therefore, they are not recommended for patients at high risk of exposure to HIV. The patients most at risk for HIV exposure are women who engage in sex work and cannot control condom use or those who are forced into high-frequency sex work (trafficking).

Cervical caps and some brands of **diaphragms** are fitted in the office to cover the cervix. After this, they are self-inserted by the patient prior to coitus. They must be used in combination with spermicide to be effective. Spermicidal sponges are spermicide-infused mesh caps placed over the cervix prior to intercourse. They do not require fittings or prescriptions.

Female condoms have the same drawbacks as male condoms—reduced sensitivity—and are also bulky, complicated structures that make them the least used method.

CONTRACEPTIVE	FAILURE RATE	DURATION	MECHANISM OF ACTION	SIDE EFFECTS AND CHALLENGES
Spermicide alone	21%	PRN	Sperm inactivation	Genital irritation Avoid if sensitive (allergic) to nonoxynol-9 Avoid if high risk for exposure to HIV
Spermicidal sponge	14%–27%	PRN	Sperm inactivation Barrier	Genital irritation
Diaphragm	17%	PRN	Barrier	Genital irritation, urinary tract infections Need to be fit in the clinic
Female condoms	21%	PRN	Barrier	Bulky, inconvenient, and frequent usage failure
Male condoms	13%	PRN	Barrier	Leave space to collect semen at the tip Never “double glove”

Table 2.5: Comparison of Pericoital Contraception Methods

Key: blue, nonhormonal methods.

Postcoital (Emergency) Contraception

Emergency contraception aims to prevent pregnancy after unprotected sexual intercourse has occurred. When it comes to emergency contraception, the sooner it is used, the more effective it is likely to be. It is ineffective once a new pregnancy has implanted. It should be made available to all patients who request it. Established pregnancy is the only absolute contraindication. All contraception and conception counseling should include education on emergency contraception. This ensures that patients are familiar with their options should they find themselves in a situation that warrants its use. The varieties of emergency contraception are **combined estradiol-progestin** pills, **progestin-only** pills, **selective progesterone receptor modulator** pills, and **placement of a copper IUD**. Each one has its advantages and disadvantages.

Many mechanisms of action have been proposed, but based on what we have taught you, some forms of emergency contraception seem more reliable than others. The first conundrum we propose is that both progestins and SPRMs with anti-progesterone effects on the endometrium are effective as contraception. The second conundrum is that copper IUDs are effective emergency contraception, whereas LNG-IUDs are not. Let's start with the one that is most obvious. **SPRMs**, such as mifepristone, are used as an abortifacient. They antagonize progesterone receptors in the myometrium and endometrium. They effectively induce massive progesterone withdrawal, the signal for a normal secretory endometrium to slough off and initiate menstruation. No endometrium, no implantation. Could it also affect the HPO axis? Possibly, but it probably doesn't. Second, **progestins** could work in one of two ways. The most obvious is **ovulation suppression**. If the ovarian cycle is in the follicular phase, then the anterior pituitary and hypothalamus are still revving up, preparing for the LH surge. Progesterone antagonizes the effect of estrogen in those tissues. Therefore, a hefty dose of progestin is going to deconstruct that process, delaying the release of the oocyte. However, the HPO axis is released once the progestin dose wears off. This means ovulation could then still occur with spermatozoa inside the patient's reproductive tract. And, if ovulation already occurred, that process wouldn't matter because the corpus luteum is already making progesterone. Although systemic progestin does suppress the HPO axis, the mechanism of action is more likely the **abrupt withdrawal of progestin**. Whether in the follicular phase or luteal phase of the ovarian cycle, a high dose of progestin that is subsequently metabolized results in a relatively precipitous decline in the progesterone signal. The endometrium interprets this as the signal to menstruate and sloughs off. Why do we suspect this mechanism? Because the single most common "side effect" is "vaginal bleeding." Perhaps that it is not a side effect or vaginal bleeding, but the mechanism of action and intended sloughing of the stratum functionale? No endometrium, no implantation. Third, **copper IUDs** are approved for emergency contraception because they have been shown to be effective. The suggested mechanism of action is the power of elemental copper, which emits spermatozoa-slaying electromagnetic rays that never run out, only affects spermatozoa and blastocysts, and causes inflammation in the endometrium but not really (there are normal uterine cycles with a copper IUD). Great. Copper IUDs are used as emergency contraception because of the copper. Soooooo . . . how about taking a bath of pure pennies! So much copper. Obviously, it's because there is a (relatively) giant object taking up a bunch of space that prevents implantation. Oh, if it's just the physical presence of the IUD, then why aren't LNG-IUDs used for emergency contraception, hmnnnn? LNG-IUDs are not used for emergency contraception **because they are not approved by the FDA for that use, not because they wouldn't work**. When you need emergency contraception, do you wanna roll the dice and be randomly assigned to the blinded treatment arm? Think "informed consent" can be obtained legitimately? No.

And so, it is most likely that the relative decrease in the progesterone signal, whether due to an SPRM or the rise and fall of exogenous progestins, causes the endometrium to slough, thus preventing pregnancy. It is also likely that the physical presence of an IUD (not the elemental copper), which blocks implantation, would be just as effective with any of the LNG-Devices. There could also be (and there likely isn't, not right away) a delay in ovulation via progestin activity on the H and P of the HPO axis. Some women lose their cycles, most don't, and certainly not right away.

The use of **combined estradiol-progestin** pills, called the *Yuzpe* method, is by far the worst emergency contraception method. Instead of Yuzpe, let's call it what it is: The *take enough of your COC to achieve the progestin dose present in real progestin-based emergency contraception* method. The goal is to increase progestin to very high levels by using the COC pills a woman already has access to. The downside of using COC to sufficiently raise the progestin level is the **toxic estrogen levels that come with it**. It should only be considered in patients who already have COC pills and little access to other forms of emergency contraception. The side effects—**nausea and vomiting**—occur in nearly all cases of its application.

Progestin-only pills are emergency contraception pills. They are available over-the-counter under various trade names (e.g., Next Choice, Plan B). Almost all of them are **levonorgestrel-containing** medications. To be effective, the **first dose must be taken within 72 hours of coitus**.

The **selective progesterone receptor modulators** (SPRM), such as **ulipristal** (available worldwide), are not preferred over LNG-containing pills when within 72 hours of coitus, but small trials have demonstrated that SPMs are effective within 72–120 hours, a time window during which LNG-containing pills are not effective. Its cousin, **mifepristone**, is not available as emergency contraception, although it is likely more effective than ulipristal. It is not available as emergency contraception because its indication is strictly for medical termination of a pregnancy.

The **copper IUD** is the most effective form of emergency contraception available when inserted within 5 days of unprotected sexual intercourse. Unlike oral emergency contraception, its efficacy is not reduced in women who are overweight or obese. It has the additional benefit of providing long-term contraception afterward as well. However, it is not easily accessible for many women as it requires being seen by a trained healthcare provider (a gynecologist) to have it placed. Saying it again for emphasis: LNG-IUDs are not ineffective as emergency contraception, but they have not been proven to be effective and therefore are not approved by the FDA for this purpose.

EMERGENCY CONTRACEPTION	SUCCESS RATES	TIME EFFECTIVE	MECHANISM	SIDE EFFECT AND CHALLENGES
Copper IUD	Best	Up to 5 days	Obstruct implantation Sperm inactivation—(they already got past it)	On insertion, none Provides ongoing reliable contraception Causes heavier menses and retains all risks included above
Ulipristal acetate (Ella)	Middle	Up to 5 days	Relative progestin withdrawal to induce menses	“Vaginal bleeding and cramping” (aka intended menses effect)
Levonorgestrel pills (Plan B, EContra EZ, My Way, Morning After Pill)	Middle	Up to 3 days	Relative progestin withdrawal to induce menses Temporary inhibitory effect on the HPO axis	“Vaginal bleeding and cramping” (aka intended menses effect)
Yuzpe method (use only when there is no other option)	Worst	Up to 3 days	Take enough COC to raise progestin to levels equivalent to those with an LNG-pill	Estrogen toxicity, nausea and vomiting, breast tenderness, headaches, dizziness

Table 2.6: Comparison of Emergency Contraception Methods

Key: blue, nonhormonal method; white, selective progesterone receptor modulator; green, progestin-only method; yellow, combined estradiol- and progestin-containing method.

Natural Family Planning

“Natural family planning” is a catch-all term that includes pre-ejaculation withdrawal and fertility awareness methods.

Typically, this method is **not used for contraception** but rather to identify when in her cycle a woman is most likely to conceive. **Abstinence** during the follicular phase of the ovarian cycle optimizes sperm count. **Sex around the time of ovulation** maximizes the chance of successful fertilization in the ampulla (at the right time), maximizing the opportunity for implantation.

Fertility awareness methods (FAM) are based on knowledge of the ovarian cycle, the timing of ovulation, and the duration of the viability of sperm and ova. This generally requires the careful tracking of menses, basal body temperature (upon ovulation, the basal temperature increases by 1°F and remains elevated throughout the luteal phase), and changes in cervical mucus viscosity, indicating ovulation patterns over many months. This data is then used to predict the fertile window in each ovarian cycle. Various smartphone apps are available to facilitate FAM.

When patients choose FAM for contraception, it is usually due to religious conviction or a desire to avoid pharmaceutical contraception. Highly motivated patients may do well with these methods, but the contraceptive efficacy with typical use is extremely low. Fertility awareness is a method of conceiving more effectively, not preventing conception.

CONTRACEPTIVE	FAILURE RATE	DURATION	MECHANISM OF ACTION	SIDE EFFECTS AND CHALLENGES
EXTREMELY EFFECTIVE				
Contraceptive implant (Nexplanon)	0.1%	3 years	Ovulation suppression	Irregular bleeding/spotting that eventually resolves
Intrauterine device (levonorgestrel)	0.1%	3-5 years	Prevent implantation Prevent endometrial proliferation	Ovarian cycles continue, breast and mood changes not affected Intended amenorrhea
Intrauterine device (copper)	0.8%	12 years	Prevent implantation Sperm inactivation	Heavier menses as ovarian and uterine cycles continue
Tubal Sterilization	< 1%	Permanent	Prevention of oocyte and sperm migration	Surgical risks, Ectopic/tubal pregnancy
Vasectomy	0.15%	Permanent	Prevention of sperm migration	Minimal procedural risks Autoimmune orchitis Reversible in most cases
REVERSIBLE METHODS AND METHODS OF MODERATE SUCCESS				
Intramuscular injection (IM medroxy-progesterone)	4%	3 months	Ovulation suppression	Irregular bleeding/spotting, Reversible loss of bone mineral density Obesity, weight gain
Progestin-only pill	7%	1 day	Progestin effects on the cervical mucus and endometrium	Irregular bleeding/spotting

Transdermal patch	7%	1 week	Suppression of ovulation	Breakthrough bleeding if used too long (hormone-free interval required) DVTs, especially in age \geq 35 tobacco smokers, and hypercoagulable state Must be avoided in breast cancer, migraines, hypertension, liver disease, coronary artery disease, or any diabetic vasculopathy
Vaginal ring	7%	3 weeks		
Combined oral contraceptive	7%	1 day		
SINGLE-USE METHODS WITH HIGH FAILURE RATES				
Spermicide alone	21%	PRN	Sperm inactivation	Genital irritation Avoid if sensitive (allergic) to nonoxynol-9 Avoid if high risk for exposure to HIV
Spermicidal sponge	14%-27%	PRN	Sperm inactivation and barrier	Genital irritation
Diaphragm	17%	PRN	Sperm barrier	Genital irritation, urinary tract infections Need to be fit in office
Female condoms	21%	PRN		Bulky, inconvenient, and frequent usage failure
Male condoms	13%	PRN		Leave space to collect semen at the tip Never “double glove”
EMERGENCY CONTRACEPTION	SUCCESS RATE	EFFECTIVE PERIOD	MECHANISM OF ACTION	SIDE EFFECTS AND CHALLENGES
Copper IUD	Best	Up to 5 days	Obstruct implantation Sperm inactivation- (they already got past it)	On insertion, none Provides ongoing reliable contraception Causes heavier menses, and retains all risks included above.
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Yuzpe method (use only when there is no other option)	Worst	Up to 3 days	Take enough COC to raise progestin to levels equivalent to those with an LNG-pill	Estrogen toxicity, nausea and vomiting, breast tenderness, headaches, dizziness

Table 2.7: Summary of Discussed Contraceptive Methods

Key: blue, nonhormonal method; white, selective progesterone receptor modulator; green, progestin-only method; yellow, combined estradiol- and progestin-containing method.